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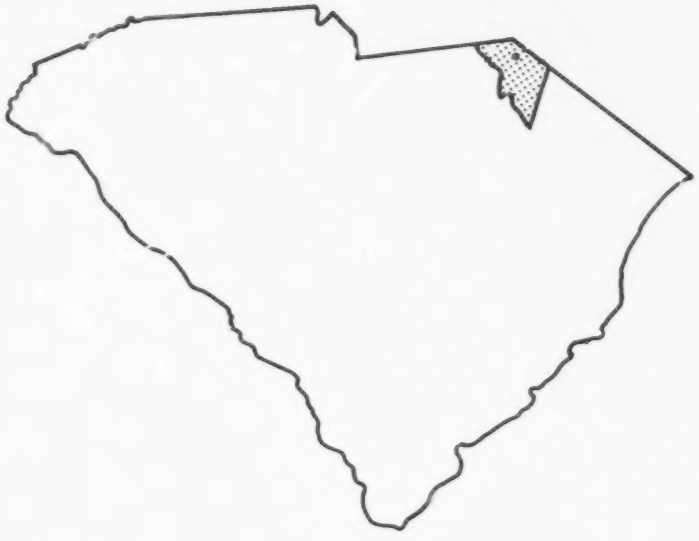
FLOOD INSURANCE STUDY

COMPLETED

ORIGINAL

CITY OF BENNETTSVILLE, SOUTH CAROLINA

MARLBORO COUNTY



AUGUST 19, 1987

Federal Emergency Management Agency

COMMUNITY NUMBER - 450147

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NOTICE TO
FLOOD INSURANCE STUDY USERS

Communities participating in the National Flood Insurance Program (NFIP) have established repositories of flood hazard data for floodplain management and flood insurance purposes. This Flood Insurance Study (FIS) may not contain all data available within the repository. It is advisable to contact the community repository for any additional data.

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FLOOD INSURANCE STUDY

CITY OF BENNETTSVILLE,
MARLBORO COUNTY,
SOUTH CAROLINA

1.0 INTRODUCTION

1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Bennettsville, Marlboro County, South Carolina, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in its efforts to promote sound floodplain management. Minimum floodplain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, floodplain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were performed by the U.S. Army Corps of Engineers (COE) (the Study Contractor) for the Federal Emergency Management Agency (FEMA), under Inter-Agency Agreement No. EMW-84-E-1506, Project Order No. 1, Amendment No. 16. This study was completed in December 1985.

1.3 Coordination

The stream requiring detailed study was identified at a meeting attended by representatives of the Study Contractor, FEMA, and the City of Bennettsville on February 29, 1984. Various state, Federal, and local agencies were contacted to obtain existing data and previously published flood information.

On September 17, 1986, the results of this Flood Insurance Study were reviewed and accepted at a final coordination meeting attended by representatives of the Study Contractor, FEMA, and the community.

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2.0 AREA STUDIED

2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Bennettsville, Marlboro County, South Carolina. The area of study is shown on the Vicinity Map (Figure 1).

Flooding caused by overflow of Crooked Creek was studied in detail.

The areas studied were selected with priority given to all known flood hazard areas and areas of projected development or proposed construction through December 1990. The scope and methods of study were proposed to and agreed upon by FEMA and the City of Bennettsville.

2.2 Community Description

The City of Bennettsville is located in central Marlboro County, in the east-central portion of South Carolina. The total land area within the incorporated area is approximately 6.7 square miles. Bennettsville is surrounded by the unincorporated areas of Marlboro County. Bennettsville is served by U.S. Routes 15 and 401, State Routes 9, 38, and 385, and by the Seaboard Coast Line Railroad. The 1980 population was reported to be 8,774, an increase from the 1970 population of 7,468 (Reference 1).

The topographic features and hydrologic characteristics of the study area are typical of the Coastal Plain physiographic region of North and South Carolina. Natural ground elevations in Bennettsville range from approximately 120 feet National Geodetic Vertical Datum of 1929 (NGVD) to 190 feet NGVD.

Crooked Creek flows southerly from Richmond County, North Carolina, to Bennettsville, South Carolina. From there Crooked Creek turns on a southwesterly course to its confluence with the Pee Dee River at the Marlboro/Chesterfield county line. The portion of Crooked Creek upstream of Lake Wallace Dam extending 1.9 miles is also known as Lake Wallace.

The climate of northeastern South Carolina is relatively temperate. The mean annual temperature is approximately 65 degrees Fahrenheit (^{o}F), with a mean high of 77 ^{o}F and a mean low of 52 ^{o}F. The average annual precipitation for the region is 54.4 inches. The precipitation is evenly distributed throughout the year, but approximately 40 percent of the annual rainfall can be expected to occur during April through August (Reference 2).

2.3 Principal Flood Problems

Portions of Bennettsville are subject to periodic flooding. The principal result is the flooding of garages, lawns, and gardens, with the resulting loss of topsoil, and a deposit of mud, filth, and refuse. Street and highway travel is disrupted, which causes the temporary loss of police, fire, and medical protection. Significant floods affecting Bennettsville occurred in 1971 and 1983, causing widespread flooding.

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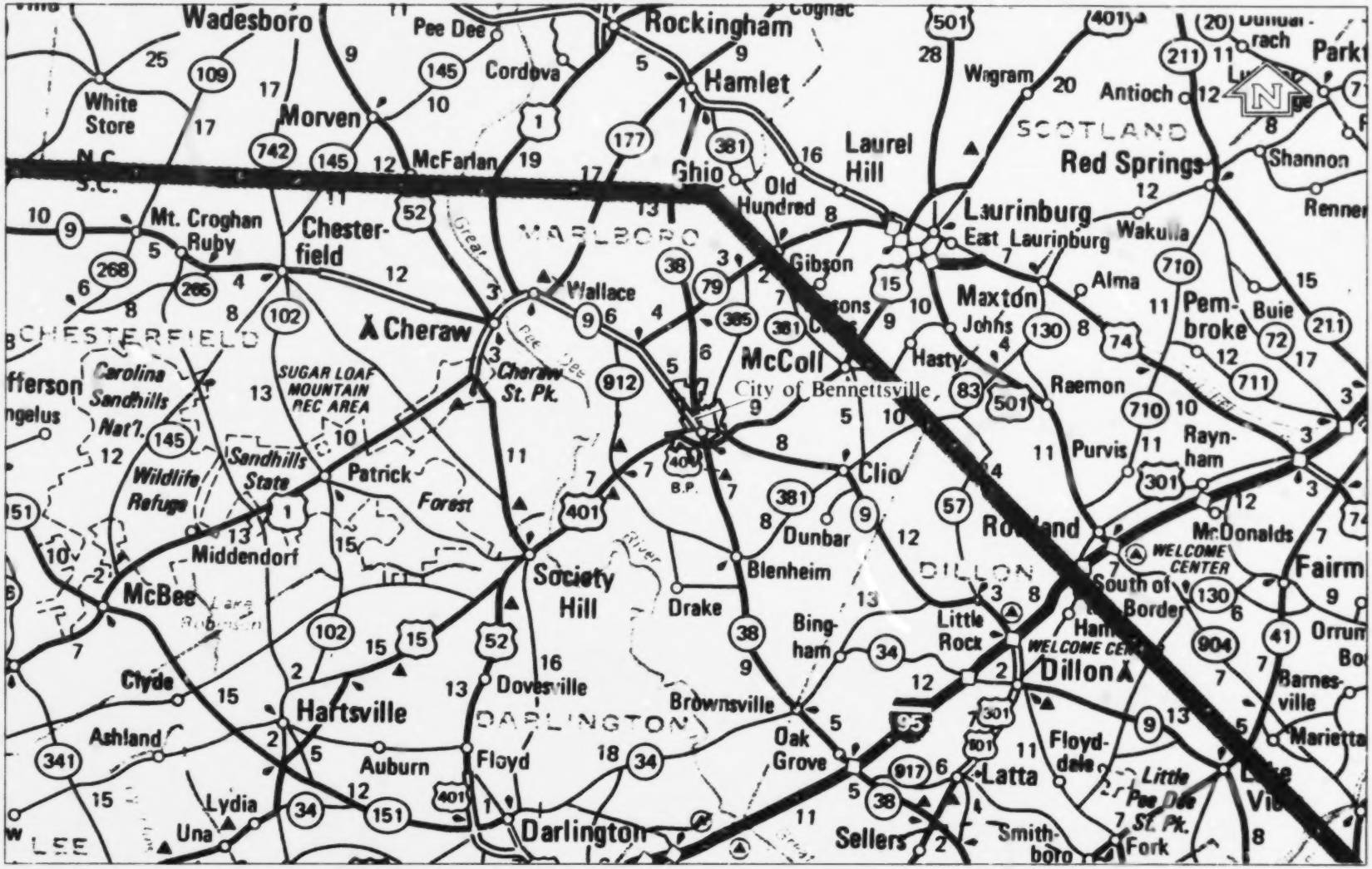

FIGURE 1

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF BENNETTSVILLE, SC

(MARLBORO CO.)

VICINITY MAP

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2.4 Flood Protection Measures

Flood protection measures in the basin include localized channel improvements and one reservoir designed to reduce flooding and flood damages. Two small reservoirs, Burnt Factory, located upstream of the community, and McCalls Millpond, located downstream of the community, do not provide any protection against flooding. Lake Wallace Dam, which is located in the community, provides protection against the 100-year event.

3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude that are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for floodplain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10-, 2-, 1-, and 0.2-percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long-term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example, the risk of having a flood that equals or exceeds the 100-year flood (1-percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each riverine flooding source studied in detail affecting the community.

Since stream gage data were not available for streams in the study area, a rainfall-runoff model utilizing unit-hydrograph techniques was used to simulate hydrologic conditions in the area. The COE HEC-1 computer program (Reference 3) was used in this analysis. Snyder's unit hydrograph was used with coefficients Tp and Cp, which were obtained from the Charleston District's regional unit hydrograph study. Rainfall values for the selected storm frequencies were taken from the National Weather Service publication Technical Paper No. 40 (Reference 4) and applied to this unit hydrograph to determine discharges at selected points along the stream.

It was considered necessary to perform reservoir routings through the three small reservoirs located on Crooked Creek. Initial runs were made with the model and the results at the reservoirs checked for overtopping. It was found that the Burnt Factory embankment overtopped at the 10-year event, Lake Wallace Dam overtopped above the 100-year event, and McCalls Millpond overtopped at the 2-year event. Because of the poor condition of the Burnt Factory embankment, it was decided to allow it to fail at overtopping. The Lake Wallace Dam did not fail until the flows were in

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excess of the 100-year event. McCalls Millpond is bypassed by a large portion of the flow during major events, thus causing high tailwater and a small depth of overtopping of the embankment. Therefore, this dam was not allowed to fail during the analysis.

Peak discharge-drainage area relationships for the 10-, 50-, 100-, and 500-year floods of each flooding source studied in detail in the community are shown in Table 1.

TABLE 1 - SUMMARY OF DISCHARGES

FLOODING SOURCE AND LOCATION	DRAINAGE AREA (SQ MILES)	PEAK DISCHARGE (CFS) 10-YEAR	50-YEAR	100-YEAR	500-YEAR
CROOKED CREEK					
inflow to McCalls Millpond	64.8	4,683	6,568	7,555	10,583
outflow from McCalls Millpond	64.8	4,668	6,568	7,557	10,590
just upstream of Lake Wallace Dam	56.0	5,417	7,162	7,960	9,020
just downstream of Lake Wallace Dam	56.0	4,653	6,155	6,949	12,795
confluence of Beverly Creek	43.1	4,684	5,792	6,088	6,471

3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Cross sections were compiled by photogrammetric methods (Reference 5) and field surveys. Cross sections were located at close intervals above and below bridges and other channel obstructions in order to compute the backwater effects of these structures. Bridge opening geometry was established by field measurements taken in November 1977.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles. For stream segments for which a floodway was computed (Section 4.2), selected cross-section locations are also shown on the Flood Insurance Rate Map.

A HEC-2 step-backwater hydraulic model (Reference 6) was developed for Crooked Creek, using basin characteristics, structural data, and discharges determined in the hydrologic analyses, to determine elevations of floods of selected recurrence intervals. Starting water-surface elevations were determined using the slope-area method.

Roughness factors (Manning's "n") used in the hydraulic computations were determined on the basis of characteristics of historical floods and existing floodplain conditions. The channel "n" value for the streams ranged from 0.020 to 0.120, and the overbank "n" values ranged from 0.040 to 0.150.

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Flood profiles were drawn showing the computed water-surface elevations for floods of the selected recurrence intervals. In cases where the 50- and 100-year flood elevations are close together, due to limitations of the profile scale, only the 100-year profile has been shown.

The hydraulic analyses for this study are based only on the effects of unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

All elevations are referenced to the NGVD. Elevation reference marks used in this study are shown on the map and described in the exhibit labeled Elevation Reference Marks.

4.0 FLOODPLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages state and local governments to adopt sound floodplain management programs. Therefore, each Flood Insurance Study provides 100-year flood elevations and delineations of the 100- and 500-year floodplain boundaries and 100-year floodway to assist communities in developing floodplain management measures.

4.1 Floodplain Boundaries

To provide a national standard without regional discrimination, the 1-percent annual chance (100-year) flood has been adopted by FEMA as the base flood for floodplain management purposes. The 0.2-percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year floodplain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps at a scale of 1:2400 with a contour interval of 2 feet (Reference 7).

The 100- and 500-year floodplain boundaries are shown on the Flood Insurance Rate Map. On this map, the 100-year floodplain boundary corresponds to the boundary of the areas of special flood hazards (Zones A, AE, AH, AO, A99, V, and VE) and the 500-year floodplain boundary corresponds to the boundary of areas of moderate flood hazards. In cases where the 100- and 500-year floodplain boundaries are close together, only the 100-year floodplain boundary has been shown. Small areas within the floodplain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

For the streams studied by approximate methods, only the 100-year floodplain boundary was delineated using the Flood Hazard Boundary Map for the City of Bennettsville (Reference 8).

4.2 Floodways

Encroachment on floodplains, such as structures and fill, reduces the flood-carrying capacity, increases the flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of

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floodplain management involves balancing the economic gain from floodplain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of floodplain management. Under this concept, the area of the 100-year floodplain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum Federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed for certain stream segments on the basis of equal conveyance reduction from each side of the floodplain. Floodway widths were computed at cross sections. Between cross sections, the floodway boundaries were interpolated. The results of the floodway computations are tabulated for selected cross sections and are shown in Table 2, Floodway Data. The computed floodways are shown on the Flood Insurance Rate Map. In cases where the floodway and the 100-year floodplain boundaries are either close together or collinear, only the floodway boundary is shown. Portions of the floodway for Crooked Creek lie outside the corporate limits.

The area between the floodway and the 100-year floodplain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the floodplain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to floodplain development are shown in Figure 2.

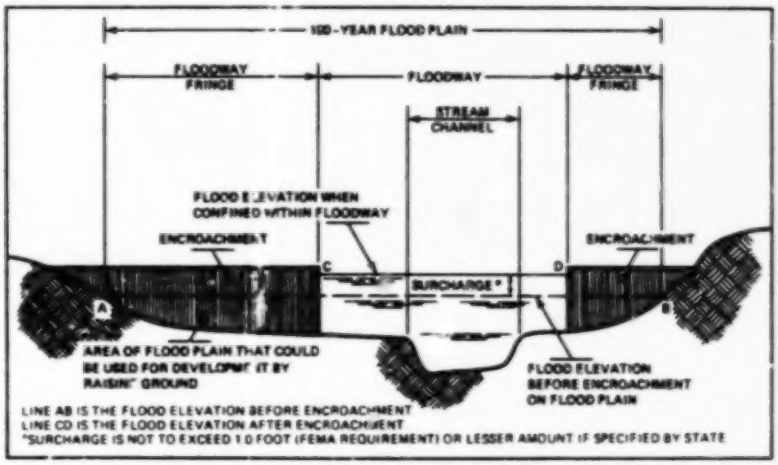
100-YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE AB IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE CD IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE IS NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE

FIGURE 2 - Floodway Schematic

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FLOODING SOURCE		FLOODWAY			BASE FLOOD WATER SURFACE ELEVATION			
CROSS SECTION	DISTANCE[1]	WIDTH (FEET)	SECTION AREA (SQ. FEET)	MEAN VELOCITY (FEET/SEC.)	REGULATORY (FEET NGVD)	WITHOUT FLOODWAY (FEET NGVD)	WITH FLOODWAY (FEET NGVD)	INCREASE (FEET)
CROOKED CREEK								
A	48,830	1997[2]	8636	0.9	124.0	124.0	124.9	0.9
B	50,900	1065[2]	4909	1.5	126.0	126.0	127.0	1.0
C	53,450	1498[2]	13,615	0.5	131.7	131.7	132.1	0.4
D	55,600	1165[2]	9419	0.7	131.9	131.9	132.5	0.6
E	57,050	740	2476	2.8	133.1	133.1	133.4	0.3
F	58,000	930	7137	1.0	133.3	133.3	134.0	0.7
G	59,100	990	6978	1.0	133.4	133.4	134.2	0.8
H	60,600	1000	3982	1.7	133.8	133.8	134.8	1.0
I	61,672	960	3499	2.0	134.6	134.6	135.6	1.0
J	62,800	1150	837	8.3	135.0	135.0	136.0	1.0
K	65,250	2610	14,732	0.5	145.7	145.7	145.7	0.0
L	69,600	2530	5967	1.2	145.7	145.7	145.7	0.0
M	70,920	2000	30,034	0.3	148.0	148.0	148.8	0.8
N	73,400	1791[2]	11,209	0.7	148.0	148.0	148.8	0.8

[1]FEET ABOVE MOUTH
[2]THIS WIDTH EXTENDS BEYOND CORPORATE LIMITS

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF BENNETTSVILLE, SC

(MARLBORO CO.)

FLOODWAY DATA

CROOKED CREEK

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5.0 INSURANCE APPLICATION

For flood insurance rating purposes, flood insurance zone designations are assigned to a community based on the results of the engineering analyses. These zones are as follows:

Zone A

Zone A is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by approximate methods. Because detailed hydraulic analyses are not performed for such areas, no base flood elevations or depths are shown within this zone.

Zone AE

Zone AE is the flood insurance rate zone that corresponds to the 100-year floodplains that are determined in the Flood Insurance Study by detailed methods. Whole-foot base flood elevations derived from the detailed hydraulic analyses are shown at selected intervals within this zone.

Zone X

Zone X is the flood insurance rate zone that corresponds to areas outside the 500-year floodplain, areas within the 500-year floodplain, areas of 100-year flooding where average depths are less than 1 foot, areas of 100-year flooding where the contributing drainage area is less than 1 square mile, and areas protected from the 100-year flood by levees. No base flood elevations or depths are shown within this zone.

6.0 FLOOD INSURANCE RATE MAP

The Flood Insurance Rate Map is designed for flood insurance and floodplain management applications.

For flood insurance applications, the map designates flood insurance rate zones as described in Section 5.0 and, in the 100-year floodplains that were studied by detailed methods, shows selected whole-foot base flood elevations or average depths. Insurance agents use the zones and base flood elevations in conjunction with information on structures and their contents to assign premium rates for flood insurance policies.

For floodplain management applications, the map shows by tints, screens, and symbols the 100- and 500-year floodplains, the floodways, and the locations of selected cross sections used in the hydraulic analyses and floodway computations.

7.0 OTHER STUDIES

Due to its more detailed analysis, this Flood Insurance Study supersedes the previously printed Flood Hazard Boundary Map for the City of Bennettsville (Reference 8).

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8.0 LOCATION OF DATA

Information concerning the pertinent data used in the preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, FEMA, 1371 Peachtree Street, NE., Suite 736, Atlanta, Georgia 30309.

9.0 REFERENCES AND BIBLIOGRAPHY

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2. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data Services, Climatological Data for South Carolina, Asheville, North Carolina, August 1973.

3. U.S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-1 Flood Hydrograph Package, Computer Program 823-X6-L2610, Davis, California, January 1973.

4. U.S. Department of Commerce, Weather Bureau, Technical Paper No. 40, Rainfall Frequency Atlas of the United States, Washington, D.C., January 1963.

5. Kucera and Associates, Inc., Strip Aerial Photographs of Marlboro County, March 1984.

6. U.S. Army Corps of Engineers, Hydrologic Engineering Center. HEC-2 Water-Surface Profiles, Generalized Computer Program, Davis, California, April 1984.

7. Kucera and Associates, Inc., Topographic Maps, Scale 1:2400, Contour Interval 2 feet: Bennettsville, South Carolina, October 1984.

8. U.S. Department of Housing and Urban Development, Federal Insurance Administration, Flood Hazard Boundary Map, City of Bennettsville, Marlboro County, South Carolina, July 1978.

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ELEVATION REFERENCE MARKS

REFERENCE MARK	FLOOD INSURANCE RATE MAP PANEL	ELEVATION (FEET NGVD)	DESCRIPTION OF LOCATION
1	0005	128.04	railroad spike 2 feet above ground in northeast side of power pole located on west side of Huckabee Street at side entrance gate to sewage treatment plant
2	0005	133.89	chiseled square cut in abutment on southwest corner of Edward Cottingham Boulevard bridge over Crooked Creek
3	0005	133.58	chiseled square cut in northwest corner of Cheraw Street bridge over Crooked Creek
4	0005	128.46	chiseled square cut in 12-inch curb at southeast corner of Marlboro Street bridge over Crooked Creek
5	0005	129.01	chiseled square cut in concrete curb on the southeast corner of Lindsay Avenue bridge over Crooked Creek
6	0005	133.15	chiseled square cut in top of 12-inch curb at southwest corner of Everett Street bridge over Crooked Creek
7	0005	171.94	railroad spike in power pole located on northwest corner of intersection of Woodland Drive and Cook Street
8	0005	147.39	chiseled square cut in 12-inch curb at northwest corner of Beauty Spot Road bridge over Crooked Creek

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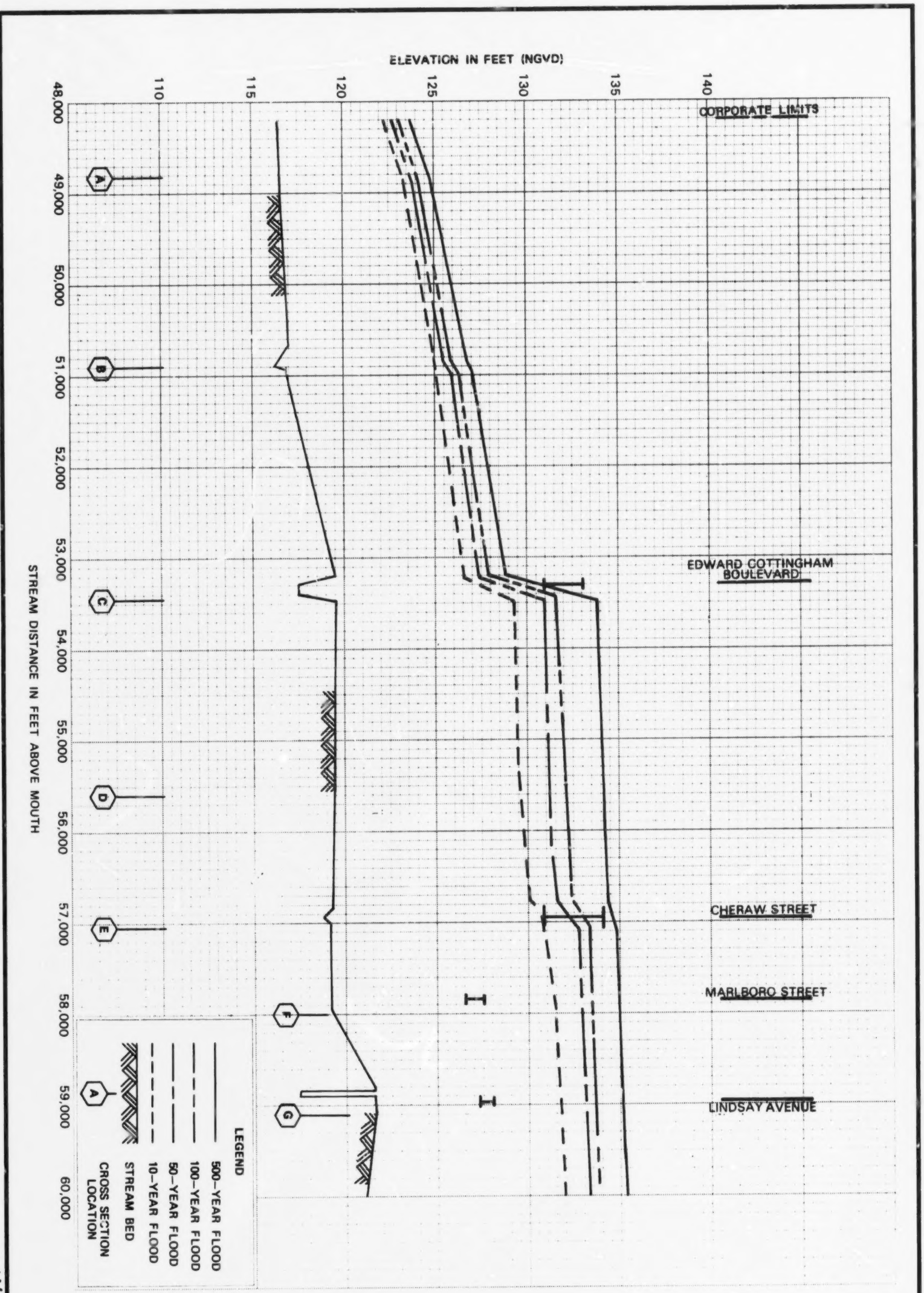

01P	FEDERAL EMERGENCY MANAGEMENT AGENCY CITY OF BENNETTSVILLE, SC (MARLBORO CO.)	FLOOD PROFILES CROOKED CREEK

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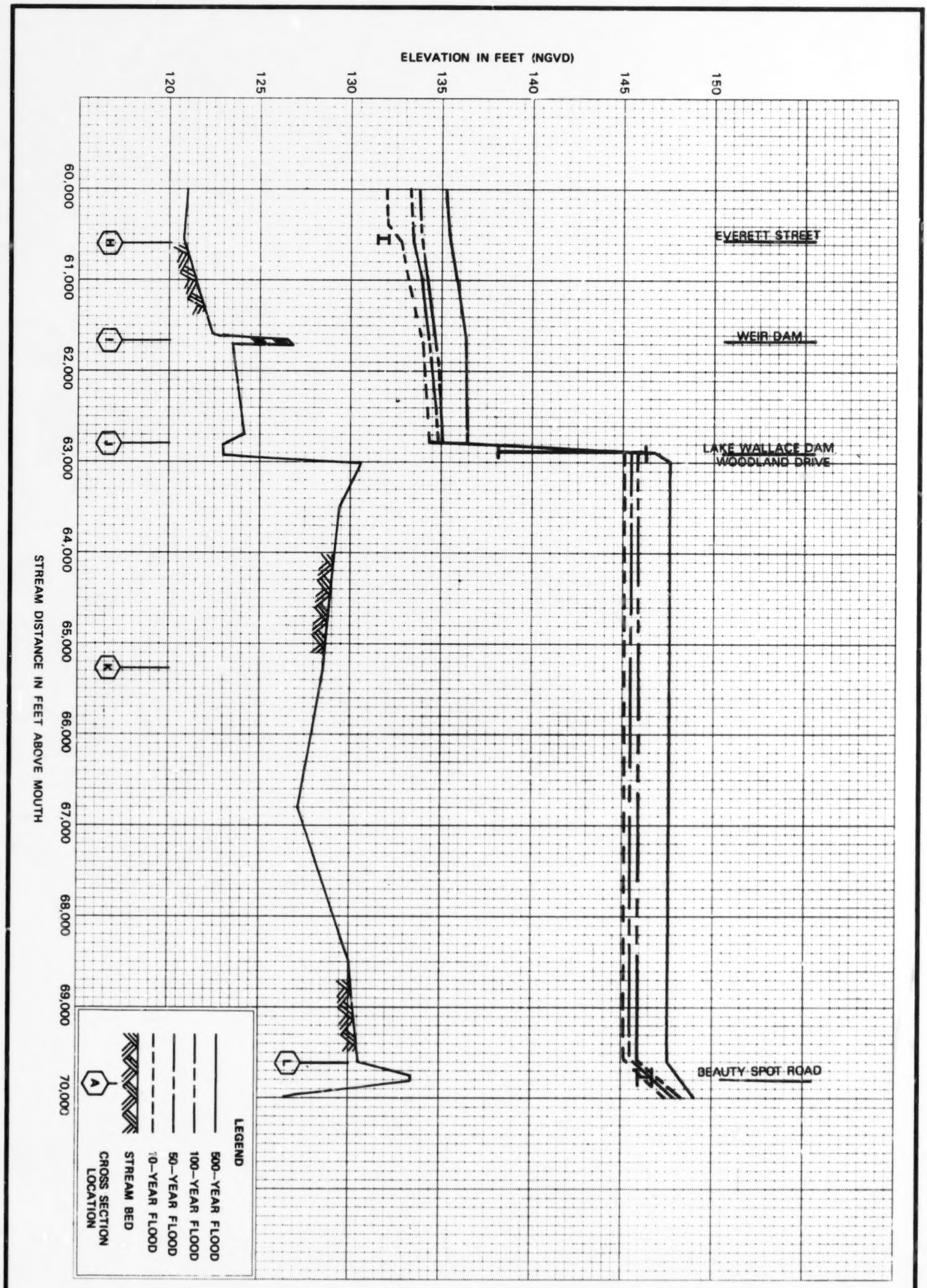

02P	FEDERAL EMERGENCY MANAGEMENT AGENCY CITY OF BENNETTSVILLE, SC (MARLBORO CO.)	FLOOD PROFILES CROOKED CREEK

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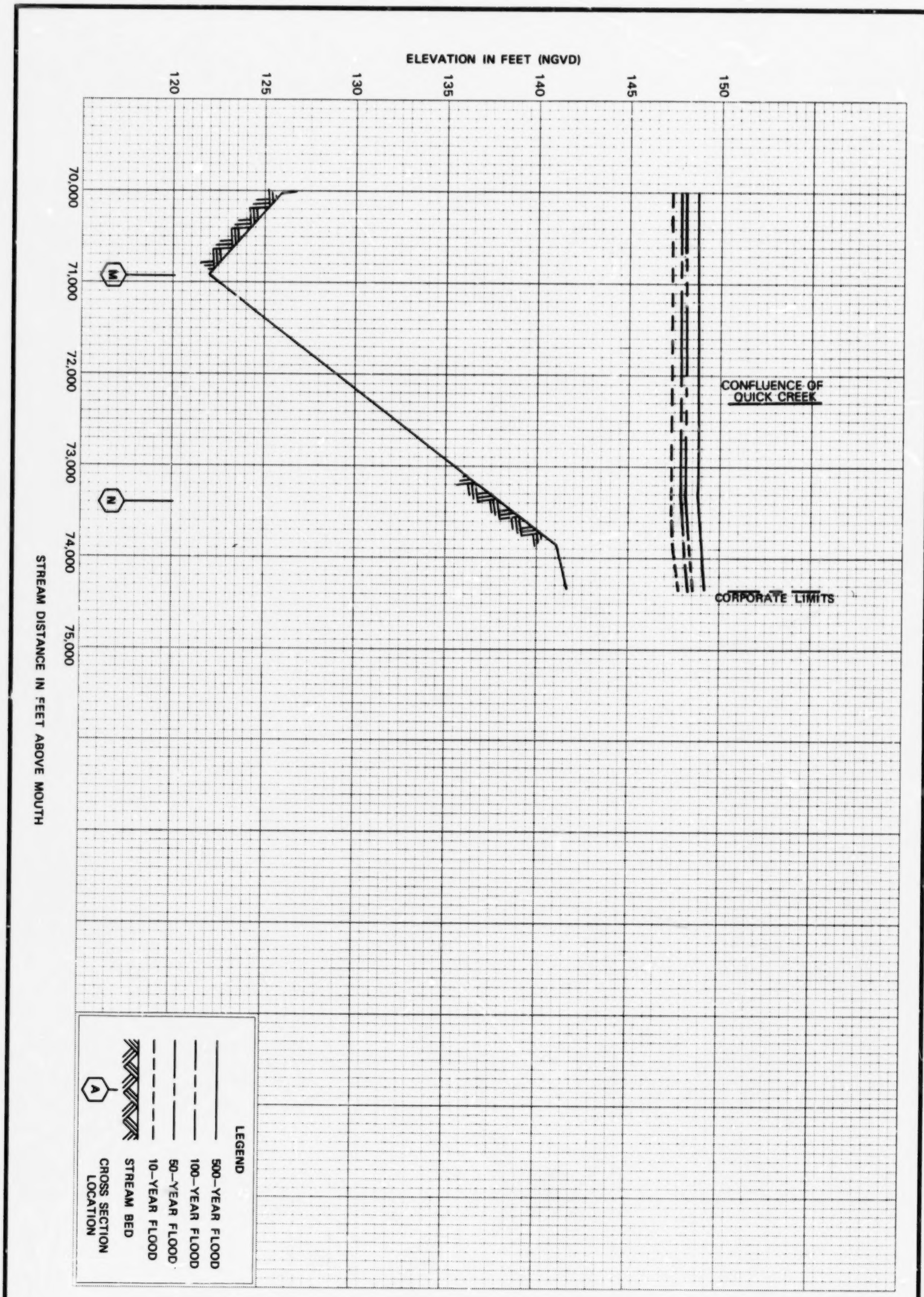

03P	FEDERAL EMERGENCY MANAGEMENT AGENCY CITY OF BENNETTSVILLE, SC (MARLBORO CO.)	FLOOD PROFILES CROOKED CREEK

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